EC412 Analog Electronics

2008-2009 Catalog Data:
Prereq: ENG EC 410. Continuation of EC 410. Topics include differential amplifiers, frequency response, operational amplifier structure and design, multistage circuit design, BJT, MOSFET, CMOS, and BiCMOS design principles, active filters and oscillators, and power devices. Includes lab. 4 cr.

Class/Lab Schedule:
LEC: 4 hrs/wk (MW 10-12). DIS: 1 hr/wk (TBA). LAB: 2 hr/wk (TBA).

Status in the Curriculum: Elective

Textbooks and other required materials:
Microelectronic Circuits and Devices, M. Horenstein, Prentice Hall, 1996.
Laboratory Manual for Electronics, M. Wasserman, Prentice Hall, 2002.

Reference:
Tuinenga, SPICE: A Guide to Circuit Simulation & Analysis Using PSpice, Prentice Hall, 1995

Coordinator:
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Prerequisites by topic:
EC410 Introduction to Electronics

Goals:
To provide students with:

- In-depth understanding of the principles of bipolar and CMOS operational amplifier design
- Extensive knowledge and perception of the high frequency behavior of amplifier circuits
- Broad knowledge of the operation of active filters, oscillators, and power devices
- Ability to design analog high frequency circuits through hands-on laboratory experiments

Course Outcomes:
As an outcome of completing this course, students should be able to:

1) Understand the use of operational amplifiers as “black box” gain elements in feedback systems
2) Understand the circuitry details of the design of an op-amp
3) Understand the use of small-signal models to predict gain and behavior in an op-amp
4) Understand the concept of poles and zeros to explain the high frequency behavior of amplifiers

5) Understand the principle of compensation and feedback to extend op-amp high freq cut-off
6) Understand the relative merits of bipolar, NMOS, CMOS, and BiCMOS in the design of op-amps
7) Understand the design tradeoffs in analog power amplifier circuits
8) Understand the characteristics of active filters and their use in analog design
9) Understand the principles of operation of an oscillator circuit
10) Implement and test linear and non-linear feedback circuits using op-amps
11) Implement and test multi-stage amplifiers using op-amp building blocks
12) Implement and test a frequency compensation network for an op-amp
13) Implement and test an active 2^{nd} order filter using op-amp building blocks
14) Design current mirror circuits in both bipolar and CMOS technology
15) Design a differential amplifier in BJT and CMOS technology and compare gain-frequency curves
16) Design and Implement an Analog Circuit Project application utilizing knowledge and skills learned
17) Collaborate with other team members on the Analog Circuit Project design and implementation
18) Write a report on the analog circuit project design, implementation, and testing results
19) Give an oral presentation and demonstration of analog circuit project implementation/results
20) Discover commercial op-amps on the market and compare data sheets using web/catalog search

Course Outcomes mapped to Program Outcomes:

Program Outcomes:	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
Course Outcomes:	1-9	10-16	10-16	10-17	1-20	1,20	18-19	1-9,20	12-20	1-20	10-17
Emphasis:	5	5	4	3	5	3	5	3	4	5	5

1=not at all; 5=a great deal;

Topics in Project Assignments:
Design and construct an analog circuit application such as an audio power amplifier, a simple ADC, an oscillator/mixer combination, an FM transmitter, an audio circuit with active filtering, an AM radio, a touch-tone control, etc. in teams of 3-4 students each. Breadboard the circuit and show functionality. Demonstrate and report on the results.

Contribution of Course to Meeting the Professional Component:
Engineering topics: 100%

Prepared by: Alexander V. Sergienko, Professor ECE **Date:** May 28, 2009